POTATO YIELD AND DRY MATTER RESPONSE TO DIFFERENT SOURCES OF POTASSIUM FERTILIZER IN ENGLAND

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INTRODUCTION

- Potassium nutrition for potatoes is critical for yield, quality and marketability, with an average of 221 kg K_2O ha^{-1} applied to potato crops in the UK.
- Potassium and magnesium are two key nutrients required for potatoes, which can have restricted availability to the plant due to the ionic antagonism of the potassium and magnesium that in turn limits yields.
- There is an enhanced interest in the usage of polyhalite ($K_2SO_4.MgSO_4.2CaSO_4.2H_2O$; POLY4) due to the recent successful exploration for polyhalite in North Yorkshire. The ratio of potassium to magnesium in POLY4 appears favourable for potato growers but limited information is available on POLY4's performance on potatoes in Europe.
- POLY4 is an alternative potassium source to MOP and SOP, with an advantage in terms of chloride content, cost, availability and delivery of Mg and Ca.

OBJECTIVES

- To generate and compare the potassium rate response curves of MOP, SOP and POLY4 for tuber yield.
- To understand whether MOP and POLY4 combinations perform better than MOP and N+P control practises for tuber yield and dry matter percentage.

METHODOLOGY

- The trial was established on loamy soils in Staffordshire, England with an initial soil analysis of P 28 mg kg^{-1}, K 106 mg kg^{-1} and Mg 44 mg kg^{-1}.
- The genotype planted was Pentland Dell.
- The previous crop was winter wheat with planting and treatment application completed on 28th April 2015.
- Ammonium nitrate provided 170 N kg ha^{-1} and triple super phosphate provided 100 P_2O_5 kg ha^{-1} and was applied two days before planting.
- Another 50 kg of N from Ammonium nitrate was applied 34 days after planting resulting in a total N application of 220 kg ha^{-1}.
- Treatments, shown in **Table 1 and 4**, were replicated four times in a randomised block design and were applied to a destoned bed and incorporated with a nematicide prior to planting.
- Each plot has two beds containing four rows of potato crop and a length of ten metres.
- Foliage was killed on 9 October 2015. The crop was irrigated twice during the growth period. All other agronomic operations were carried out as per the standard local practise.
- Statistical analysis was carried out using GenStat software version 17 (VSN International, 2011) using ANOVA and regression analysis. Treatments of interest in the source study were compared using a single degree of freedom contrasts.

CONCLUSION

- The rate response study of potassium fertilizers showed POLY4 to be more effective at improving yields than MOP but similar to SOP.
- Decreasing dry matter percentage with increasing K_2O rate was observed for MOP but not for SOP or POLY4 treatments.
- POLY4 and MOP combinations recorded numerically higher yields than the 100% K source (MOP).

RESULTS – RATE RESPONSE STUDY

- Potassium application irrespective of source significantly improved potato yield above the control (N+P).
- No significant differences were observed between MOP, SOP or POLY4. However, potato yields were 2% (ie 1.2 t ha^{-1} (mean of the 100, 200, 300 and 400 kg K_2O ha^{-1})) higher for POLY4 treatments than the MOP or SOP treatments.

	Fertilizer applied (kg ha^{-1})			Nutrients applied (kg ha^{-1})				
Treatment/ variables	MOP	SOP	POLY4	K_2O	MgO	CaO	S	Cl
1	-	-	-	-	-	-	-	-
2	167	-	-	100	-	-	-	80
3	333	-	-	200	-	-	-	160
4	500	-	-	300	-	-	-	240
5	667	-	-	400	-	-	-	320
6	-	200	-	100	-	-	34	6
7	-	400	-	200	-	-	68	12
8	-	600	-	300	-	-	102	18
9	-	800	-	400	-	-	136	24
10	-	-	714	100	43	121	136	21
11	-	-	1429	200	86	243	272	43
12	-	-	2143	300	129	364	407	64
13	-	-	2857	400	171	486	543	86

Table 1 – Type, rate and amount of the nutrients supplied by each treatment for rate response study

	Yield (t ha^{-1})			Tuber dry matter (%)		
Treatment/ variables	Equation	r^2	p	Equation	r^2	p
MOP	y = 48.9-1.52*(0.9704^x)	0.39	<0.001	y = 24.085-0.14*(1.00648^x)	0.3	0.005
SOP	y = 48.77-11.39*(0.863^x)	0.46	<0.001	y = 23.53+0.3604*(0.863^x)	n/a	0.501
POLY4	y = 49.98-12.6*(0.863^x)	0.61	<0.001	y = 23.8+0.09167*(0.863^x)	n/a	0.965

Table 2 – Regression analysis of tuber yield and dry matter

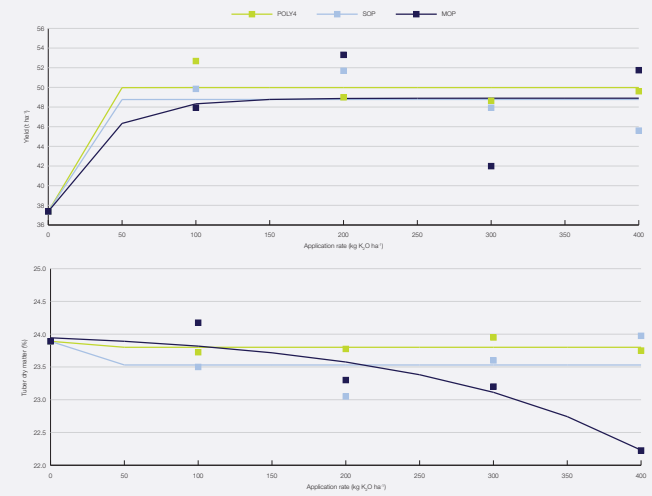

Figure 1 – Regression plot fresh tuber yield and tuber dry matter

Variable	Control	Control * Type	Control * Rate	Control * Type * Rate
Tuber dry matter (%)	0.054	0.028	ns	0.004
Yield (t ha^{-1})	<.001	ns	ns	ns
Yield > 45mm in diamater (t ha^{-1})	<.001	ns	ns	ns
Yield 50mm (t ha^{-1})	<.001	ns	ns	ns
10 kg tuber count (Number of potatoes)	0.058	ns	ns	ns
Marketable yield (%)	0.071	ns	ns	ns

Table 3 – Analysis of variance p values for the measured variables in rate response study

RESULTS – POTASSIUM COMBINATIONS STUDY AT RECOMMENDED K_2O RATE

- All of the treatment combinations containing both MOP and POLY4 significantly outperformed the control (N+P) except for the 100% K source (MOP) which performed on par. This could be due to the addition of magnesium, calcium and sulphur in POLY4.
- The results suggest that the ratio and source of magnesium to potassium is more important to consider than the application of additional MgO.

Variable	Type
Tuber dry matter (%)	ns
Yield (t ha^{-1})	0.009
Yield > 45mm in diamater (t ha^{-1})	0.002
Yield 50mm (t ha^{-1})	ns
10 kg tuber count (Number of potatoes)	ns
Marketable yield (%)	0.059

Table 5 - Analysis of variance p values for the measured variables in K combination study

	Fertilizer applied (kg ha^{-1})			Nutrients applied (kg ha^{-1})				
Treatment/ variables	MOP	POLY4	Kieserite	K_2O	MgO	CaO	S	Cl
1	-	-	-	-	-	-	-	-
2	-	-	320	-	80	-	64	-
3	500	-	-	300	-	-	-	240
4	420	343	-	300	21	58	65	212
5	376	530	-	300	32	90	101	196
6	190	1330	-	300	80	226	252	131
7	-	2140	-	300	128	364	407	64
8	420	343	238	300	80	58	113	212
9	376	530	192	300	80	90	139	196

Table 4 – Type and amount of the nutrients supplied by each treatment for source evaluation study

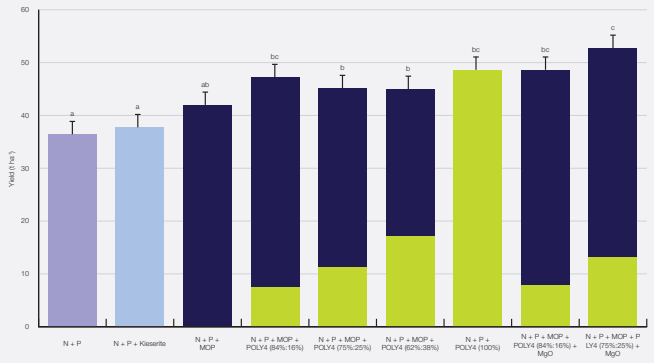

Figure 2 – Total potato yields under different potassium fertilizer combinations